RECONFIGURABLE TACTILE INTERFACE UTILIZING ACTIVE MATERIAL ACTUATION

BACKGROUND OF THE INVENTION

[0001] 1. Technical Field

[0002] This disclosure generally relates to tactile human-machine interfaces, such as buttons, knobs, dials, etc, and more particularly to an interface or control that utilizes active material actuation to change a first geometric shape, orientation, position or otherwise characteristic of the interface.

[0003] 2. Background Art

[0004] Human-machine interfaces (HMI's) have long provided facilitating means for entering user-generated input into a communicatively coupled system. Among these, tactile interfaces, such as buttons, knobs, dials, etc., allow a user to manually enter an input. For example, in an automotive setting, knobs are often rotated by a user to change an aspect of a telematic, entertainment, diagnostic, wiper, or HVAC system. That is to say, manipulation of a volume knob may resultantly cause a potentiometer to slide, thereby increasing or decreasing power to the speaker system and volume.

[0005] It is appreciated by those of ordinary skill in the art, however, that the use of conventional tactile HMI's present various concerns in the art; for example, as exemplified in an automotive setting, the user is often required to temporarily draw his or her attention away from a main task, such as properly operating the vehicle, in order to distinguish amongst a plurality of similarly sized and shaped HMI's. In a dimly lit or dark space (e.g., the interior cab of a vehicle while driving at night) selecting the desired interface may be further obfuscated. Once selected, it is known in the art to release a detent or latch by depressing the HMI, so as to cause it to extend towards a more readily manipulated position; however these configurations require even more attention than static HMI's. Of further concern, it is also appreciated that engagement between a variety of user hand sizes and a one-size-fits-all HMI configuration often results in a tactile HMI that is difficult to manipulate for certain users.

BRIEF SUMMARY

[0006] In response to the afore-mentioned concerns, the present invention involves a reconfigurable tactile human-machine interface that utilizes active material actuation to selectively (e.g., on demand, etc.) and autonomously drive reconfiguration. Thus, the inventive HMI is useful for facilitating selection and manipulation by a user, for offering visual confirmation of (hands-off) selection by the user, and for reducing the amount of attention necessary to distinguish amongst a plurality of interfaces. As such, in automotive settings, the invention is useful for reducing work load of a vehicle operator, for example, by reducing eyes-off-road time, and the likelihood of feature lock-outs resulting from eyes-off-road time. By changing its geometric shape and/or size, the reconfigurable interface facilitates use with a variety of user hand sizes, and improves ergonomics particularly for challenged individuals. Moreover, with respect to consumer gratification, the ability to change HMI's in accordance with user preference enables increased personalization.

[0007] Finally, it is appreciated that usage of active material elements, as presented herein, reduces weight and/or complexity in comparison to counterpart mechanical, electromechanical, hydraulic, or pneumatic based systems. Moreover, it is appreciated that active material use increases energy efficiency, and reduces the likelihood of failure as well as costs associated therewith.

[0008] A first aspect of the invention concerns a tactile human-machine interface adapted for facilitating identification by a user and modification of the associated system. In one embodiment, the interface includes a reconfigurable body presenting a first geometric shape. The body is communicatively coupled to and operable to modify at least one condition of the system when manually manipulated. The interface further includes at least one active material element drivenly coupled to the body. The body and element may be integrally formed. The element is operable to undergo a reversible change in fundamental property when exposed to or occluded from an activation signal; and the change causes the body to achieve a second geometric shape, orientation, position, or characteristic.

[0009] Thus, a second aspect of the invention concerns a method of facilitating selection of a tactile human-machine interface by a user, wherein the interface presents a first geometric shape. The method includes the steps of securing the interface relative to a source operable to expose the interface to an activation signal, and selectively causing the interface to be exposed to the signal. The geometric shape of the interface is modified as a result of being exposed to the signal, prior to selection. After selection and/or variously after use of the interface, after vehicle shutdown, by demand, or after appropriate sensor input, the signal is discontinued, and the interface is reversibly modified back to the first shape.

[0010] Other aspects and advantages of the present invention, including the employment of shape memory alloys, shape memory polymers, and other active materials for actuating, and utilizing sensor input/voice activation will be apparent from the following detailed description of the preferred embodiment(s) and the accompanying drawing figures.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

[0011] A preferred embodiment(s) of the invention is described in detail below with reference to the attached drawing figures, wherein:

[0012] FIG. **1** is a perspective view of a plurality of human-machine interfaces (HMI's) operatively coupled to an entertainment system/controller, a microphone/sensor coupled to the system, and a signal source coupled to the system/controller and HMI's, in accordance with a preferred embodiment of the invention;

[0013] FIG. **1**A is an elevation of the front interior cabin of a vehicle, particularly illustrating a wiper system, and active material based HMI's associated with the wiper system, in accordance with a preferred embodiment of the invention;

[0014] FIG. **2**A is a cross-sectional elevation of an HMI presenting an upper portion having an enlarged diameter and comprised of an active material, in accordance with a preferred embodiment of the invention;

[0015] FIG. **2**B presents cross-sectional elevation and planar views of an HMI presenting an upper portion having an enlarged diameter and including an internal EAP or shape memory strip, in accordance with a preferred embodiment of the invention;

[0016] FIG. **2**C is a cross-sectional elevation of an HMI presenting an upper portion having an enlarged diameter and including an embedded active material element, and first and